NATURAL PROPAGATION AND HABITAT IMPROVEMENT

VOLUME I - OREGON

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ANNUAL REPORT, 1983

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WHITE RIVER FALLS FISHERIES INVENTORY

ANNUAL REPORT, 1983

BY

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ABTRACT

Biological and physical characteristics of White River drainage were studied in 1983 to determine the feasibility of introducing anadromous salmonids into the watershed. Access to White River by anadromous fish is presently blocked by waterfalls located 3.4 km from the confluence with the Deschutes River.

Mortality of juvenile chinook salmon from a 43 m free fall at White River Falls does not appear to be significant during high flows (300-500 cfs) but may be significant at low flows (115-150 cfs). At low flow the recapture of fish released in the south channel above the falls was 54% lower than the recapture of control fish released below the falls. The recapture of two releases in the north channel was 37% lower than the recapture of control groups.

We surveyed 94 km of the lower reaches of 7 tributaries below the boundary of the Mt. Hood National Forest. We identified 8,325 n2 of anadronous spawning gravel of which 52% was good quality, 20 water withdrawals for irrigation that took a total of 33 cfs of water, 13 barriers to upstream migration of which 3 were waterfalls of 3.1-7.6 m and 138 major holding and rearing pools. Maximum water temperatures of 250C or greater and diurnal fluctuations of around 10°C were recorded in the lower reaches of several streams. The maximum water temperature in upper reaches of streams above the forest boundary was 13-14°C. Habitat improvement opportunities identified in surveys of the lower reaches included barrier modifications for upstream passage, in-stream structures to develop pools and retain gravels, structures to reduce bank erosion, and streamside fencing to protect riparian zones.

Rainbow trout, brook trout, whitefish, cottids, dace, and largemouth bass were the only resident species of fish found in White River. Of the salmonids, rainbow trout were the most widely distributed and most abundant in the watershed. Brook trout were limited to upper reaches of the mainstem White River and its tributaries. Whitefish were found only in the lower mainstem. Cottids were well distributed and second only to rainbow trout in abundance. In the tributaries 90% of the rainbow trout and 95% of the brook trout were <150 mm in length. In the lower mainstem 62% of the rainbow trout were >150 mm. There were no viruses detected in rainbow trout or brook trout in the fall, but bacterial kidney disease was found in both species in Boulder, Barlow, and Clear creeks, and in Clear Lake.

INTRODUCTION

Runs of salmon and steelhead from the Deschutes River in Oregon have been subjected to mortality aColumbia River dams since the construction of

Deschutes River are being mitigated by Portland General Electric Company.

However, neither, these runs nor those below the project have been compensated for the additional mortality occurring at Columbia River dams. These losses in the could be compensated for in part by developing self-sustaining runs of salmon and steelhead in White River. White River is the second largest tributary in the lower 161 km of the Deschutes River; however, access to White River by anadromous salmonids is blocked by a falls 3.4 km above its confluence with the Deschutes.

In 1983 the Oregon Department of Fish and Wildlife (ODFW) completed the first year of a 2 year study of the feasibility of developing self-sustaining runs of anadronous salmonids in White River basin. The study is funded by the Bonneville Power Administration (BPA) and is being conducted in conjuntion

with the U.S. Forest Service, Mt. Hood National Forest, and with Ott Water Engineers, a private consulting firm from Rellevue, Washington. The 1983 work statement to BPA describes the goals and objectives of the White River Study and gives additional background information. Only those tasks in the work statement in which the ODFW was directly involved in field sampling will be described in this report. This includes tasks 1.2, 1.3, 2.1-2.4, and 3.1-3.3. Work completed under Task 1.1 is reported in Ott (1984). That completed in Mt. Hood National Forest under Tasks 1.3, 2.1, and 2.4 is reported in Heller et al. (1984).

STUDY AREA

White River is located in North-Central Oregon and is bounded on the east by the Deschutes River, on the west by the Cascade Range, on the north by Hood River and Fifteenmile Creek, and on the south by the Warm Spring River. White River heads on the Southeastern slopes of Mt. Hood in White River Glacier and flows 80.5 km east to its confluence with the Deschutes River at km 74, 4 km above Sherar's Falls. Because of its glacial source, White River is seasonally subjected to heavy silt loads. The extent of this siltation is dependent on snow pack and summer temperatures and occasionally is severe enough to drastically discolor the Deschutes River (Fig. 1). White River Falls is located 3.4 km upstream from the confluence of White River with the Deschutes River. The Falls is located 3.4 km upstream from the confluence of White River with the Deschutes River. The falls is actually a series of three separate falls, each a barrier tc upstream migration. The first two falls are about 6-8 m high (Figs. 2 and 3) and the third is approximately 43 m high (Fig. 4). Tributaries of White River as well as flow and temperature stations are shown in Fig. 5.

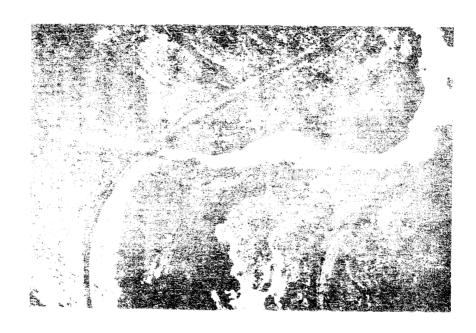


Fig. 1. Discoloration of the Deschutes River by glacial silt from White River in summer 1977.

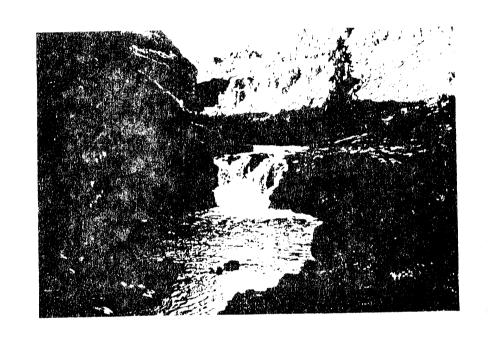
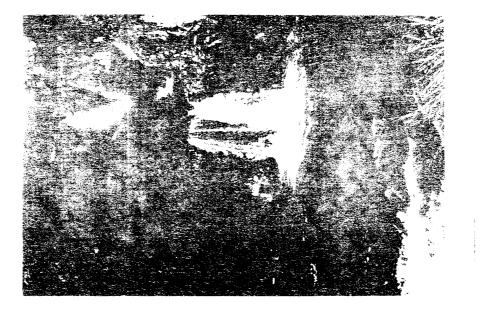
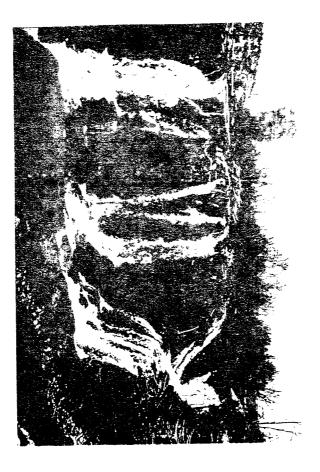


Fig. 2. Lower White River Falls.





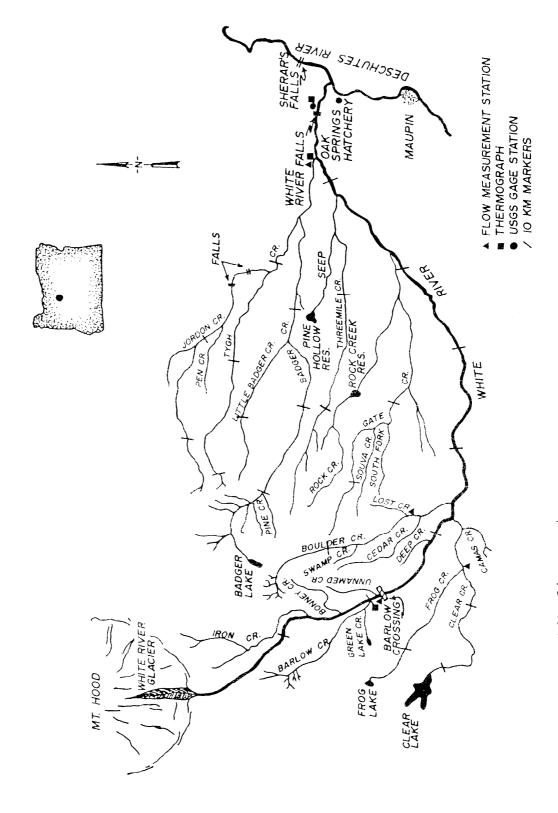


Fig. 5 Map of the White Ri er system

METHODS AND MATERIALS

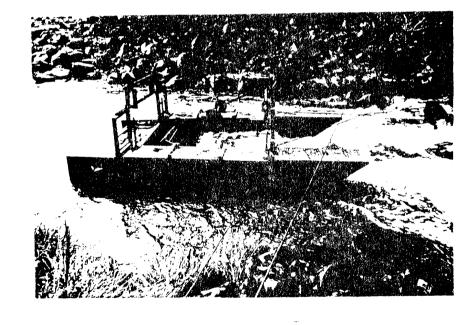
Task 1.2

Survival of juvenile salmonids over White River Falls was studied during two flow periods in 1983. Tests were conducted in May and June (high flows) and in October (low flows). These periods approximate the timing of migrations of juvenile salmonids in the Deschutes River. Spring chinook and summer steelhead were released above and below White River Falls and recaptured at a Humphrey scoop trap below the falls (Fig. 6).

Each release group was uniquely marked with a freeze brand (Fig. 7) at Round Butte Hatchery and held at the hatchery for 1-7 days before releases. A subsample of each group was measured (fork length) at the time of branding. Fish were transported to release sites in a portable tank and released (Fig. 8).

Test groups were released at various locations 30-50 m from the lip of the upper falls in areas protected from the current. Upstream passage of the test fish was blocked by a 2.5 m high concrete dam (Fig. 9). The dam was originally constructed by Pacific Power and Light Company to divert flow into the penstock of their generating facility located below the upper two falls. The facility was abandoned in 1928. Control groups were released in a large pool below the lower falls just upstream from the scoop trap (Fig. 10).

Fish recaptured in the trap were examined for brands and injuries. A subsample of each release group in the trap was measured to the nearest 1 mm fork Thingth. During fall, 20 fish recaptured from each release group were neld in a live box for 3 days to determine if there was delayed mortality due to passage over the falls.



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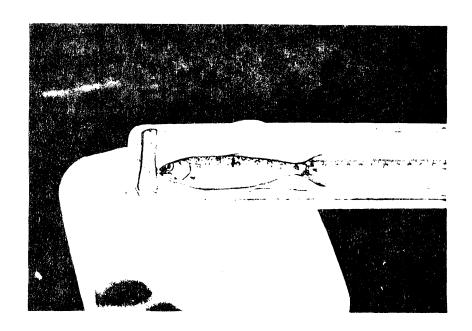


Fig. 7. Spring chinook with freeze brand for survival tests at White River Falls.

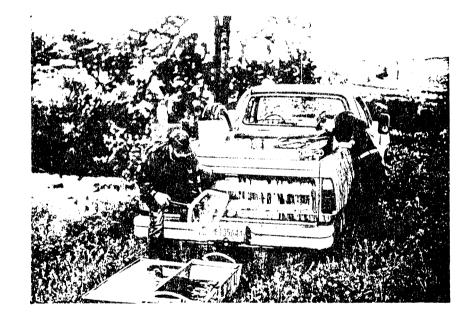


Fig. 8. Relea of ' | for White Rive | Is | tests



Fig. 9. Release of test fish above White River Falls (barrier dam is in the background).

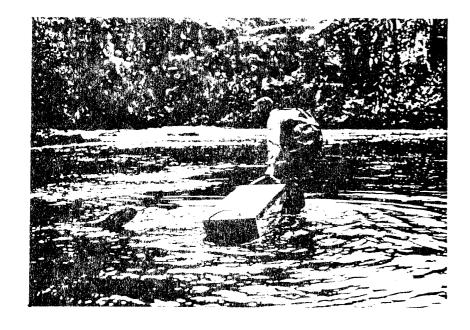


Fig. 10. Release of control group below White River Falls.

Comparisons between recaptured rates of release groups were made with a two-way analysis of variance. Procedures for estimating missing values (due to unequal replications) were from Snedecor and Cochran (1980) and from Steel and Torrie (1980).

Estimates of steelhead that did not migrate were made by mark and recapture techniques. Steelhead were captured with a seine and by hook and line, marked with a partial caudal finclip, and returned to the river. Recaptures were made with the same gear on subsequent days and estimates were calculated by the Schnabel or Petersen method (Ricker, 1975).

Task 1.3

Sites where water was being diverted from White River and its tributaries were identified on private, state, and BLM lands under Tasks 2.1 and 2.4. The location and the type of diversion (pump or ditch) was noted. The amount of water being removed was also estimated. Diversions on national forest lands were identified by Heller et al (1984).

Task 2.1

A review of the literature and discussions with other biologists were used to develop several methods of estimating the potential of White River basin to produce anadromous fish. Actual estimates of potential will not be made until 1984, but a discussion of some of the methods that may be used can be found in the Results Section of this report.

Various elements of fish habitat were quantified to provide background data to better assess potential anadromous production in White River.

Spawning gravels, holding pools, and rearing areas were identified on private, state, and BLM lands from late July through September (Fig. 11). Streams were also surveyed to determine differences in pool-riffle ratios, in gradient, in

shade, and in substrate among stream segments. These latter data will be used to establish stations in various types of stream segments that will be sampled more intensively in 1984 to estimate potential. Flow and temperature were also monitored at selected sites (Fig. 2).

Two people surveyed each stream from the mouth upstream until reaching the end of the survey section (generally the national forest boundary).

Spawning gravel area, pool characteristics (width, depth, cover), substrate composition, and pool-riffle ratios were visually estimated and recorded at 0.8 km intervals. Length and width of large pools were estimated with a Ranging 100 range finder. Large areas of spawning gravel were paced to estimate area. Spawning gravel was subjectively classified as good or marginal denending on flow, location in the channel, and substrate compaction. Escape cover and shading were also noted near spawning gravels. Gradient was measured by sighting a Sunto PM 5 clinometer at a range po?e along a 30.5 m section of stream Flows at water diversions and in tributaries were estimated by multiplying the cross-sectional stream area by the velocity as measured by a floating object (Hynes, 1970).

In addition to flow estimates during the surveys, flows were measured at permanent transects in the watershed (Fig. 2). Water depth and velocity were measured at 0.3, 0.5, or 1.3 m intervals depending on the width of the stream elocity was measured at a point 0.4 of the depth from the substrate with a Gurley meter (Fig. 12). Discharge was calculated by summing products of velocity and nor vevarice area for all segments of the transect. Staff gauges were installed to each flow measurements it and water levels were recorded by weekly to develop a curve that will relate gauge heights to stream flow. Flows at permanents ites will be compared to the flows at the USGS

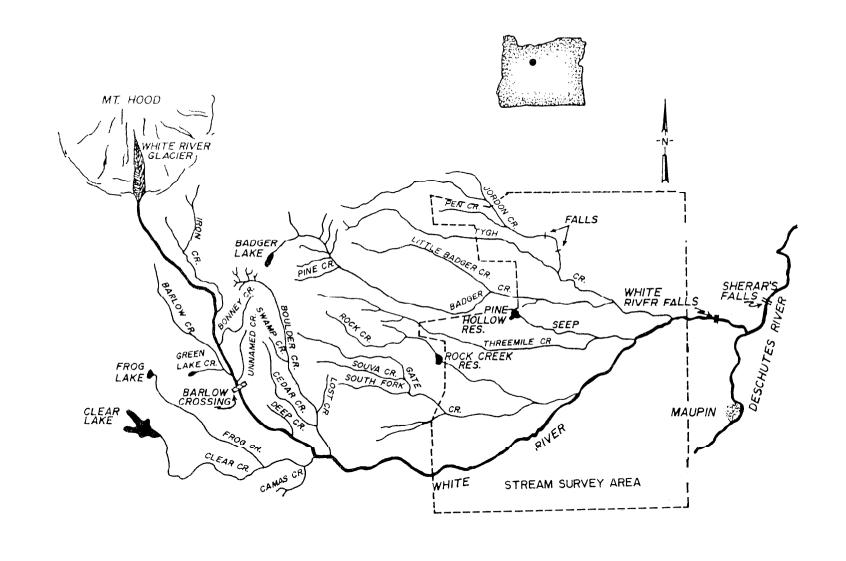
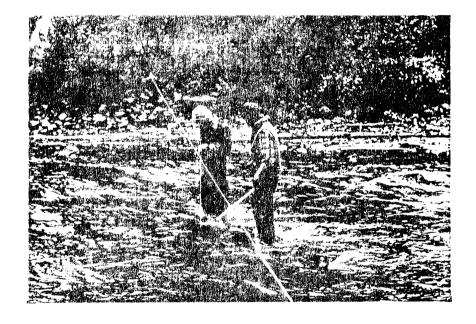


Fig. 11. Stream survey area on state, private, and BLM lands. Streams on national forest land were surveyed by USFS.



and the second of the second o

gauging station below White River Falls to determine relative contribution from major tributaries. Data on flows at these various sites will be incorporated into stream production indexes in 1984.

Water temperatures were measured continuously with Partlow thermographs at 3 stations and weekly with Taylor maximum minimum thermometers at 17 stations (Fig. 2). These data will also be incorporated into stream production indexes in 1984.

Task 2.2

We did not determine the species best suited for the habitat in White River in 1983 pending completion of Tasks 2.1, 2.3, and Objective 3.

Task 2.3

Crossing (Fig. 13) and in 8arlow Creek (Fig. 14) to determine the effects of glacial silt on survival. The fish were collected with backpack electrofishing gear in Barlow Creek, One group was held in a live box for 7 days during a period of heavy siltation in White River. The other control group was held for the same period in Barlow Creek. The fish were later examined for overt physical damage and gill arches were extracted for examination.

Task 2.4

Opportunities for habitat improvement were identified during stream surveys described in Task 2.1.

Task 3.1

A three-person crew conducted an inventory of resident fish species throughout the White River drainage to determine species composition, distribution, and relative abundance. Age structure and growth of rainbow and brook trout were also determined.



Fig. 13.

ating effects of glacial silt

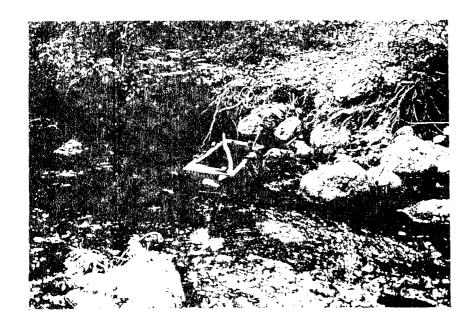


Fig. 14. Live box in Barlow Creek for control group in tests of glacial silt.

Sampling in the tributaries was conducted with Dirago backpack electrofishing gear (Fig. 15) at 1.6 km intervals. The average site was 23 m in length and the sampling time averaged 23 minutes. Attempts were made to maintain consistency in the lengths of sample sites, sample time, and electrofishing technique. Exceptions were in lower Tygh and Badger creeks because of difficulty in sampling the large pools. Middle and upper areas of White River were difficult to sample because the stream is both large and inaccessible. A 3.2 km section of lower White River was intensively sampled with Smith-Root electrofishing gear mounted in a drift boat (Fig. 16).

Fork lengths and numbers of rainbow and brook trout were recorded in 5 size categories (Fig. 17) and fish were returned to the stream Scales were co'ilected from 10 fish in each of 4 size groups (0-5, 5-10, 10-15, >15 cm) in each stream with additional scales collected in larger streams. Scales and length data will provide baseline information on age and growth characteristics. Other information recorded in the field included substrate, width and depth, cover, and pool development (boulders, woody debris, stream meanders).

Task 3.2

Samples of rainbow trout and brook trout were collected for disease examination from 12 areas of White River drainage (Fig. 18). Fish were collected with backpack electrofishing gear in the mainstem and tributaries and with gill nets in the lakes. The samples were transported to the Pathology Laboratory at Oregon State University and examined for the presence of fish diseases and parasites.



Fig. 15. Resident fish inventory with backpack electrofishing gear.

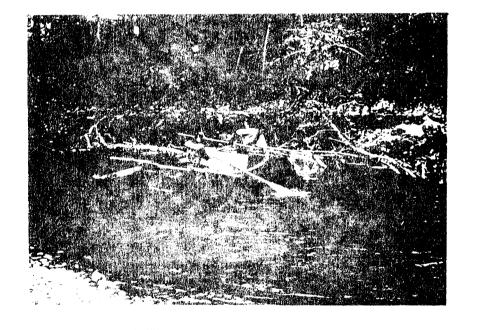


Fig. 16 Resident

ELECTROFISHING FORM

Stream:				Stream	1 M14e:	
Site:	N	lumber:		Site De	escription_	
andmarks:						
			<u>:</u>	Cr	.ew:	
		Fish Sp	ecies, Size	e and Abunda	ance	
		Numb	er Per Size	Group (cm)	+	
Species	0-5	5-10	10-15	15-20	<u>></u> 20	Scale Sample Number
						•
				 		
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Comments:						
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Fig. 17. Data form for resident fish inventory of the White River system.

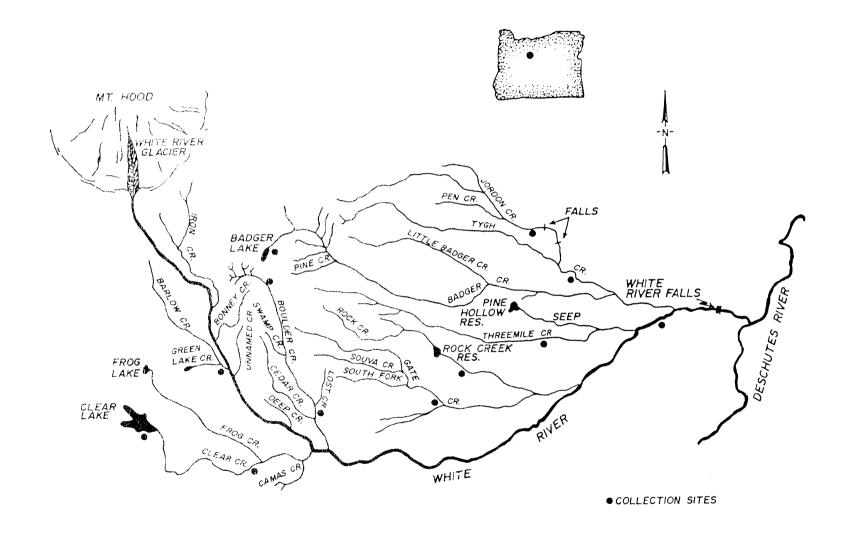


Fig. 18. Sites where inbow rout and brook trout were collected for disease examination in White River drainage.

Task 3.3

There was no assessment of potential impacts of anadromous fish introduction on resident fish in 183 pending completion of Tasks 3.1 and 3.2.

RESULTS AND DISCUSSION

Task 1.2

We released 5,331 juvenile spring chinook and 10,890 juvenile summer steelhead in White River from May 9 through June 14 (Tables 1 and 2). Recapture rates of juvenile chinook released above White River Falls did not differ significantly from the control groups (Table 3 and 4). The results indicate there was no significant mortality of juvenile chinook in a free fall passage of White River Falls during high flows (300-500 cfs).

Although data indicated there was not a significant mortality of juvenile steelhead at White River Falls (Tables 5 and 6), the low number of recaptures (2-33) makes this conclusion tenuous. Recapture rates were highest for the first release, which was hand-graded for juveniles with smolt-like characteristics, but dropped to zero recaptures in replicate five. Population estimates indicated 871 (95% CI = 689 - 1,097) steelhead remained at the control release site at least 2 weeks after the last release. Of these fish over 50% were from the last control release. An estimated 677 (95% CI = 248 - 1,692) test steelhead remained above the falls at least 2-3 weeks after the last release. In addition, steelhead were found between the test and control release sites and in the north channel above the falls, although there were not enough fish at either location to make an estimate. By contrast only 13 juvenile chinook were sampled in all locations.

 $\frac{\omega}{\omega}$

Table 1. Number of juvenile chinook released and recaptured in White River, 1983.

- parallegge by the egg of Miller II also contains the contains the contains and the		Numb	per releas	ed	na, in ana antara e i mai auman ne men membrani musi indiamenthina		Number rec	aptured		
Date	S. main	N. channel	N. main	Penstock	Control	S. main	N. channel	N. main	Penstock	Control
May 9	502	*** ***			510	126				100
May 18	422	433			423	116	100			103
June 7	510	510			511	108	122			123
June 13	515		486		509	68		76		48
Total	1,949	943	486		1,953	418	222	76		374
Oct 10	329		322	an. we	325	50		75		122
Oct 17	314		322	336	322	77		82	85	156
Oct 24	346		320	319	314	63		89	86	115
Oct 31	315		317	320	318	53		68	99	/ 131
Total	1,304		1,281	975	1,279	243		314	270	524

Table 2. Number of juvenile steelhead released and recaptured in White River, 1983.

		Number released		N	lumber recaptured		
Date	S. main	N. channel	Control	S. main	N. channel	Control	
May 10	350	~-	350	32		33	
May 17	993		1,002	33		57	
June 1-2	1,006	1,032	1,027	7	10	12	
June 6	1,031	1,021	1,027	2	7	2	
June 14	1,000		1,050	0		0	
Total	4,380	2,053	4,457	74	17	104	

Table 3. Recaptures (%) of juvenile chinook salmon released above and below White River Falls, spring 1983.

	Below the	Above the falls		
Replication	falls	S. main	N. channel	
1	19. 6	25.1		
2	24.3	27.5	23.1	
3	24.1	21.2	23.9	
4	9.4	13.2		

Table 4. Analysis of variance between recapture rates of juvenile chinook released above and below White River Falls, spring 1983.

Source of	Degrees of	Suns of	Mean	
variation	freedom	squares	square	F
Replications	3	355.63	118.54	
Freatments	2	13.12	6.56	1.02
Error	4	25.62	6.41	
Total	9	394. 37		

Table 5. Recaptures (%) of juvenile steelhead released above and below White River Falls, spring 1983.

	Below the	Above the falls		
Replication	falls	S. nain	N. channel	
1	9.4	9.1	um ==	
3	5.7	3.3	<u></u>	
4	0.2 1.2	0.7 0.2	0.7 1.0	

Table 6. Analysis of variance between recapture rates (Varcsin transformation) of juvenile steelhead released above and below White Riser Falls, spring 1983.

Source of variation	Degrees of freedom	sums of squares	Mean square	F
Replications Treatments Error	3 2 _ 4 _	391.22 4. 91 5.20	130.41 2.46 1.30	1.89
Total	9	401.32		

Only 1.3% of the chinook and 2.2% of the steelhead recaptured in the scoop trap were injured. Injuries observed were damage to the eye, subcutaneous hemorrhages, and hemorrhages at the base of fins.

We released 4,839 juvenile spring chinook into White River from October 10 through 31 (Table 1). Recapture rates of fish released above the falls was significantly lower than for the controls (Tables 7 and 8). Among test groups, fish released in the main channel (south main) were recaptured at a significantly lower rate than those released in the two north channels (north main and penstock). The mean recapture rate of releases into the south main channel were 54% lower than the control and 27% lower than the two combined north channel releases. These data suggest a significant mortality over the falls at low flows (115-150 cfs).

Table 7. Recaptures (%) of juvenile chinook salmon released above and below White River Falls, fall 1983.

		Common pages on Angelocomous & A. Nacio (2004) of the Service	Above	_
Replication	Below	S. main	Penstock	N. main
1	37. 5	15. 2	ger sta	23. 3
2	48. 5	24. 5	25.3	25. 5
3	36. 6	18. 2	27.0	27.8
4	41. 2	16. 8	30. 9	21.5

Table 8. Analysis of variance between recapture rates of juvenile chinook released above and below White River Falls, fall 1983.

Source Gf variation	Degrees of freedom	Sum of	Mean _ square	F
Replications	3	71. 24	23. 75	
Treatments	5	1,071.4	357. 14	24.82**
Tests vs. control	1	930. 16	930. 16	64.64**
Anong tests	2	141. 25	70. 63	4.91*
'Error	8	115.11	14. 39	
Total	14	1,257.76		

^{*| **} indicates statistical significance at the 0.05 and 0.01 levels, respectively.

There was a significant difference between the mean length of test fish at release and their mean length at recapture (p<0.05), but no difference in control fish between release and recapture. Test fish were significantly larger at the time of recapture which suggests either smaller fish survived passage at the falls at a lower rate than larger fish or that smaller fish did not migrate as well as larger fish. It is not known to what extent, if any, the test fish might have residualized in pools between the falls and the trap.

The chinook used for tests in the fall had been exposed to bacterial kidney disease (BKD) at Round Butte Hatchery which may have affected survival at the falls. We hand-graded fish and rejected those that exhibited signs of BKD such as reddening at the base of fins and exothalmus. Heavily infected fish probably would have died from the stress of handling and transportation, however it is difficult to ascertain how lower levels of BKD might have reduced survival at the falls (telephone conversation February 7, 1984, R. Holt, Pathologist ODFW, Corvallis).

Injuries observed in recaptures in fall were low (3.5%). Injuries sustained during low flow could be fatal, thus not observed in the recaptures. We held 20 chinook from each release as a check for delayed mortality. The only mortality during the 3-day test was in a control group.

Task 1.3

We identified 20 water diversions below the national forest boundary (Table 9, Figs. 19 and 20), of which 85% were located in Tygh and Badger creeks. An estimated 16-18 cfs is withdrawn from Tygh Creek from km 2.1 to 15.6. The flow measured at the permanent transect (km 1.3) on Tygh Creek was about 7 cfs from August to mid-September. Water withdrawals on Badgar Creek removed an estimated 13 cfs. The flow at km 1.6 in Badger Creek in mid-August

was <2 cfs while the flow at km 9.5 near the forest boundary was approximately 17 cfs. Eight ditches on Tygh and Badger creeks would require screening to protect downstream migrants.

A major diversion dam on Threemile Creek (km 19.2) diverted all flow to an irrigation ditch and to Pine Hollow Reservoir and left a dry channel for 5 km downstream (Table 9). A second dam upstream diverts water to Rock Creek Reservoir. These two structures are permanent and are operated through winter and spring to fill Pine Hollow and Rock Creek reservoirs, These ditches would require screening to protect downstream migrants. Most water withdrawals on Rock and Gate creeks occurred in Mt. Hood National Forest (Heller et al 1984).

Table 9. Water withdrawals on seven streams surveyed in the White River system, 1983.

erit (sample- upditeinitze) i Almer Christift, Aribianistin e alik eritikus illim alikus illim silk saaritus Kunisti ka	Location	wah	Water withdrawal	Punp
<u>Stream</u>	. (km)	Туре	(cfs) a	size (HP)
Tygh Creek	2. 1	Pump	0. 1	1.5
	4. 5	Ditch (pump)	2.0(0.8-1.6) <i>b</i>	(15-30)
	7. 6	Ditch	3. 3	
	9. 3	Ditch	4. 5	
	9. 7	Pump	0. 8	15
	11.4	Pump	0. 8	15
	11.6	Ditch	1. 5	- 0
	12. 2	Punp	0. 1	3.0
	12. 4	Punp	0. 3	7.5
	12.9	Pump	0. 8	15
	13. 2	Pump	0. 2	5.0
	14. 3	Punp	0. 1	1.5
	15. 6	Di tch	1.5	
Badger Creek	1.8	Ditch	6. 0	
o	2. 1	Ditch	2. 0	
	2. 4	Punp	0. 1	1.5
	7. 1	Ditch	5. 0	
Threemile Creek	19. 2	Ditch	2.5	
	20. 0	Ditch	1.5	
Gate Creek	3. 1	Punp		

PM--"
Approximate discharge rates for pumps based on type and head.

b Estimated discharge for pump of unknown size. Pump to main irrigation line estimated at 15-30 HP.

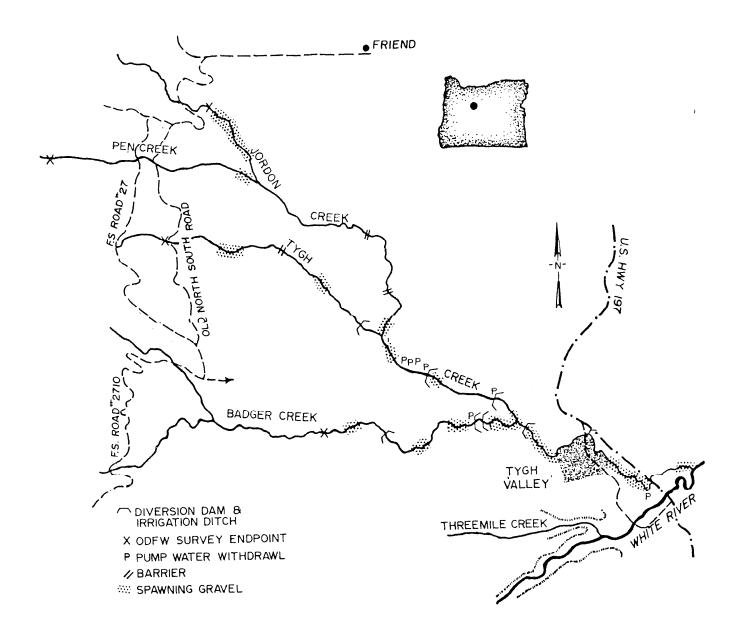


Fig. 19. Locations of water diversions, migration barriers, and concentrations of spawning gravel in the Tygh Creek system.

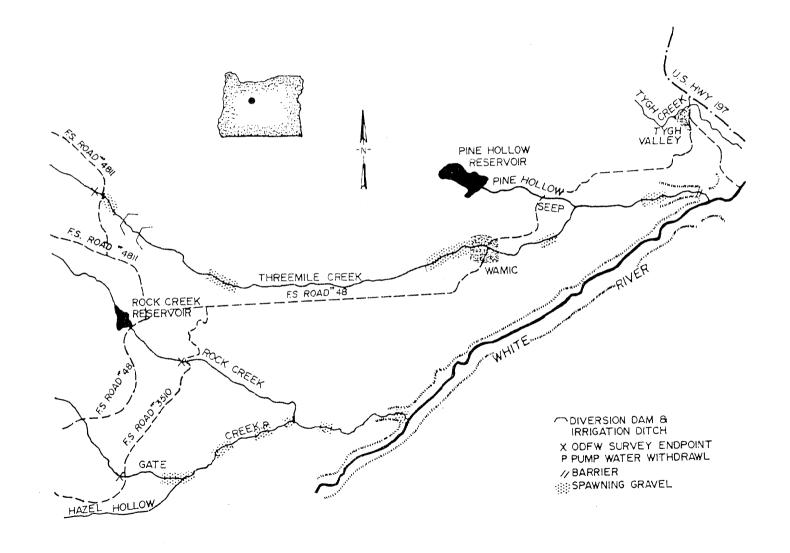


Fig. 20. Locations of water diversions, migration barriers, and concentrations of spawning gravel in Threemile, Rock and Gate creeks.

Task 2.1

Habitat surveys

Approximately 94 km of stream were surveyed below the national forest boundary from July 13-September 1. Tygh, Jordan, Pen, Badger, Threemile, Rock, and Gate creeks were surveyed. Based on stream gradient, pool-riffle ratio, shade, and changes in stream flow, we defined 16 reaches on these seven streams (Table 10).

Table 10. Reaches below the forest boundaries in the White River system, 1983.

			Reach Average				
		Length			Shade		
Stream	Reach (km)	(km)	(%)	Pool: Riffle	(%)		
Tygh Creek	0. 0- 8. 9	8. 9	0. 9	49:51	31		
78	8.9-15.0(Jordan Cr.)	6. 1	1. 2	34:66	37		
	15.0-24.1	9. 1	1. 9	32:68	62		
Jordan Creek	0.0 - 3.5(2nd falls)						
001111111	3. 5- 12. 1	3.5	1.8	40:60	44		
		8.6	0.7	38:62	47		
Pen Creek	0. 0 - 3.2	3.2	1.3	40:60	48		
	3.2- 8.1	4. 9	3.3	23:77	76		
Badger Creek	o. o- 4. 1	4. 1	1. 8	43:57	37		
	4.1- 7.2	3.1	0.7	13:87	44		
	7.2- 9.7	2.5	1.2	33:67	40		
Threemile Creek	0. 0- 19. 3	19. 3	1. 5	56:44	52		
	19. 3- 20. 5	1.2	2.5	20.80	63		
Rock Creek	0. 0 - 4.8	4.8	2.8	80:20	33		
	4.8-10.5	5.7	1.3	80:20	48		
Gate Creek	o. o - 7.3	7.3	1.4	58:42	44		
	7.3- 8.9	1.6	1. 0	65:35	70		

Spawning gravels

Of the 8,325 m^2 of spawning gravel surveyed below the forest boundary 52% was classified as good gravel because of composition, condition

(embeddedness, siltationj, flow, or location in the channel (Table 11). We found 76% of the spawning gravel in 25 major areas (Table 12, Figs. 19 and 20). The majority of the good gravel was found in the lower 8.0 km and 3.0 km of Tygh Creek and Badger Creek, respectively. Other major areas were located in Jordan Creek and in the middle section of Threemile Creek. Much of this gravel is in smaller concentrations than in lower Tygh and Badger creeks. Gravel in Badger Creek and the lower 12.0 km of Tygh Creek was composed mostly of a larger particle size (7.5-15 cm) while the other sections had predominantly smaller gravels (2.5-7.5 cm) (Table 13).

Table 11, Spawning gravel for anadromous fish in seven streams in White River drainage, 1983.

		Length	Spawning gravel (m		
Stream	Reach (km)	(km)	Good	Marginal	
Tygh Creek	0.0- 8.9	8. 9	1, 742	1, 571	
	8.9-15.0(Jordan Cr.)	6. 1	508	296	
	15.0-24.1	9. 1	216	199	
Jordan Creek	0.0 - 3.5(2nd falls)	3. 5	76	140	
	3.5-12.1	8. 6	195	185	
Fen Creek	0.0- 3.2	3. 2	113	149	
	3.2- 8.1	4. 9	43	39	
Badger Creek	o. o - 4.1	4.1	550	392	
8	4.1- 7.2	3. 1	36	286	
	7.2 - 9.7	2. 5	65	92	
Threemile Creek	0. 0- 19. 3	19. 3	390	349	
	19. 3-20. 5	1. 2	56	34	
Rock Creek	0.0- 4.8	4. 8	60	90	
	4. 8- 10. 5	5. 7	95	64	
Gate Creek	o. o- 7. 3	7.3	102	104	
	7.3- 8.9	1.6	59	29	
Total		93. 9	4, 306	4, 019	

Table 12. Major concentrations of spawning gravel in seven streams in the White River system, 1983.

	Location	Size	Qual	ity (m ²)
Stream	(km)	(m ²)	Good	Marginal
Tygh Creek	0 0 0 0	٥٢	43	42
Tygh Creek	0.0- 0.8	85		
	1.6- 4.8	2,005	1,135	870
	5.6-8.0	993	467	526
	10.5-11.3	158	39	119
	12.9-13.7	293	250	43
	17.7-18.5	70	43	27
	21.7-23.3	247	122	125
Jordan Creek	0.0- 0.8	107	38	69
	8.0-12.1	299	166	133
Pen Creek	0.0- 1.6	116	64	52
Badger Creek	0.0.1.6	623	370	253
badger creek	0.0- 1.6		143	97
	2.4- 3.2	240		233
	4.0- 4.8	235	2 29	255 26
	8.0- 8.9	55	29	20
Threemile Creek	1.6- 2.4	39	20	19
	5.6- 6.4	116	65	51
	8.9-10.5	181	103	79
	14.5-16.1	82	54	28
	19.3-20.6	90	56	34
Rock Creek	0.0- 0.8	67	42	25
NOCK OF CCK	3.2- 4.0	34	8	26
Gate Creek	0.0- 0.8	27	15	12
5.55	2.4- 3.2	23	17	6
	4.0- 4.8	62	29	33
	7.2- 8.9	88	<u> 59</u>	29
Total		6,335	3,349	2,986

Table 13. Substrate composition of riffles in seven streams surveyed in the White River system, 1983.

					Substra	ate (%)			
Stream	Location (km)	Bedrock	Large boulder (XO.9m)	Small boulder (0.3- 0.9m)	Rubble (15- 30.5 am)	Large gravel (7.5- 15 cm)	Small gravel (2.5- 7.5 cm)	Fine gravel (0.25- 2.5 cm)	Sand/silt (<0.25 cm)
Tygh Creek	0.0- 8.9	0	0	2	40	38	12	8	0
	8.9-15.0(Jordan Cr.)	0	0	3	37	41	14	5	0
	15.0-24.1	1	3	16	38	20	15	6	1
Jordan Creek	0.0- 3.5(2nd falls)	19	19	24	16	10.5	10.5	1	0
	3.5-12.1	19	7	16	35	6.5	6.5	4	6
Pen Creek	0.0- 3.2 3.2- 8.1	0 1	0 3	9 17	41 32	7 8	43 34	0 5	0
Badger Creek	0.0- 4.1	0	5	18	40	26	4	7	0
	4.1- 7.2	2	5	23	50	14	4	2	0
	7.2- 9.7	0	5	35	35	16	4	5	0
Threemile Creek	0.0-19.3	5	6	12	26	12	20	6	13
	19.3-20.5	0	0	15	50	6	24	2 . 5	2.5
Rock Creek	0.0- 4.8	0	35	20	10	2	8	5	20
	4.8-10.5	0	4	14	6	7	14	25	30
Gate Creek	0.0- 7.3	7	16	20	23	11	14	6	3
	7.3- 8.9	0	0	5	3 0	18	27	20	0

In addition to the $8,325~\text{m}^2$ of usable gravel, 1,500~n2 of potential spawning gravel were exposed during the survey period. These areas will be surveyed during February-April, 1984 to determine their suitability for steel head.

Pools

Stream sections below the forest boundary contained 138 major pools (Table 14). Pools were subjectively defined as such based on velocity and depth relative to the size of the stream. The potential of these pools as adult holding or juvenile rearing habitat is influenced by such factors as water temperature, instream cover and shade.

The lower 8 km of Tygh Creek and the lower 4 km of Badger Creek contained 29% of the major pools. Juvenile rearing potential in these larger pools may be limited because of low to moderate cover and high water temperatures. Pools in lower Jordan Creek (km 0.0=3.5) had good cover and shading. Pen Creek had little flow and only a few pools were noted in the first 2.0 km

Threemile Creek contained 20% of the major pools but many had poor cover and only noderate shading. Pool quality was influenced by low summer flows (<1 cfs). Many pools had a silty substrate and a poorly-developed riparian zone due to livestock overgrazing. Rock and Gate creeks had little flow which left many potential pools dry.

Migration barriers

Thirteen migration barriers were identified during stream surveys below the forest boundary (Table 15 and Figs. 19 and 20). Of these, ten were man-made structures for irrigation. There were also several retention dams to provide water for irrigation pumps but these were not barriers to upstream migration. Modification of diversion dams would be necessary for

Table 14 Major pools in seven streams surveyed in White River drainage, 1983.

and the state of t					Average	
Stream	Reach (km)	Number	Length (m)	Width (m)	Depth (m)	Cover (%)
Tygh Creek	0.0- 8.9	23	16.2	5.5	1.1	37
	8.9-15.0(Jordan Cr.)	7	9.4	4.0	0.7	40
	15.0-24.1	16	5.2	2.4	0.8	54
Jordan Creek	0.0- 3.5	12	10.1	7.3	1.9	65
	3.5-12.1	5	5.8	4.0	0.9	48
Pen Creek	0.0- 3.2	7	5.2	2.7	0.5	47
	3.2- 8.1	1	2.4	2.4	0.5	40
Badger Creek	0.0- 4.1	17	9.4	4.3	0.8	46
	4.1- 7.2	2	9.1	5.5	0.8	45
	7.2- 9.7	7	10.1	4.0	0.9	39
Threemile Creek	0.0-19.3 19.3-20.5	27 -	15 2 -	4.0	0 6	32
Rock Creek	0.0- 4.8	6	14.0	7.0	0.6	40
	4.8-10.5	3	13.7	4.6	0.9	40
Gate Creek	0.0- 7.3	4	25.0	4.6	0.7	50
	7.3- 8.9	1	61.0	3.0	0.9	40

anadromous fish to pass at low flows in summer and some would need to be modified for passage at high flows as well. The irrigation season usually begins in April (depending on winter/spring precipitation) and ends in October or November, Many of the structures are not in place beyond this period.

Table 15. Migration barriers for anadromous salmonids during low summer flow in seven streams in the White River system, 1983.

Stream	Location (km)	Type of barrier	Height (m)	Passage likely at high flows	Description
Tygh Cree	k 4.5	Diversion dam lpha	0. 9	Yes	Concrete, steel
	7. 6	Diversion dam $^{\mathcal{Q}}$	0.8	Yes	Concrete, gravel
	9. 3	Diverison $\operatorname{dam} a$	1.5	Yes	Concrete, steel
	11.6	Diversion dam $^{\mathcal{Q}}$	0.8	Yes	
	15. 6 20. 2	Diversion dam Falls	2. 1 3. 1	Yes No	Wood
Jordan	1.4	Falls	7. 6	No	
Creek	3. 5	Falls	5. 2	No	
Badger	1.8	Diversion dam lpha	0. 9	Yes	Wood, plastic
Creek	2. 1	Diversion dam $^{\mathcal{Q}}$	0. 9	Yes	Concrete
	7. 1	Diversion dam lpha	0. 8	Yes	Wood, plastic
Threemile	0. 0- 1. 1	Falls, chutes	0. 6- 2. 0	Yes	
Creek	19. 2	Diversion dam lpha	0. 6	Yes	Concrete, steel
	20. 0	Diversion dam lpha	0. 6	Yes	Boul ders

a Structure is removed at least partially during tinter and spring.

In addition to White River Falls, waterfalls that block upstream migration are located at km 1.4 and 3.5 on Jordan Creek and at km 20.2 on Tygh Creek (Fig. 21). These are major falls with vertical drops of 3.1 to 7.6 m Two smaller falls on Tygh Creek (km 16.3 and 17.3) are formed by large boulders with step-like vertical drops which should be modified to provide easier passage during low flows. Tygh Creek contained several woody debris dams which could require some modification for passage. Modifications should be made without damaging pools or spawning gravels associated with the



Fig 21 1 4

debris. Because flow is intermittent, modifications to debris dams on Pen
Because flow is intermittent, modifications to debris dams on Pen Creek would
probably be of marginal benefit and would be contingent on passage at Jordan
Creek Falls. All woody debris dams were considered potential passage barriers
because of the difficulty in assessing passage through or over these dams at
various flows.

Low flow in Threemile, Rock, and Gate creeks could cause passage problems in some boulder-dominated sections and in some shallow riffles. A series of Small falls and chutes in the first kilometer of Threemile Creek is a barrier at low flow and may also prevent passage at higher flows.

Flows

Natural low flows in August and September are further reduced by irrigation withdrawals as noted in Task 1.3. These low flows not only limit passage, they will also limit, to an unknown degree, the potential of rearing areas, holding areas, and spawning gravels for anadronous fish. Low flows also increase water temperatures (see section on water temperatures).

Estimates of flow measured at 4 stations from July through November indicate flows in mainstem White River at Barlow Crossing and in Tygh, Clear, and Boulder creeks account for 72% of the flow recorded at the USGS gauging station (Tabie 16) near the mouth of White River. Springs, small tributaries, ground water, and irrigation runoff below the 4 stations supply additional flow. Because of its regulated flow, Clear Creek contributed an equal percentage (13%) of flow through summer to lower White River as Tygh Creek, despite the larger drainage area of the latter, Almost half (43%) of the flow recorded in lower White River was attributed to the mainstem at Barlow Crossing approximately 56 km upstream Discharge in White River during 1983

Table 16. Flows at permanent stations in upper White River and selected tributaries and at the U.S.G.S. gauging station in lower White River, 1983.

Location Km		River		Creek .3	Clear 6		Boulder 3	r Creek .5		River .2
Dates	m ³ /sec	ft ³ /sec	m ³ /sec	ft ³ /sec	m ³ /sec	ft ³ /sec	m ³ /sec	ft ³ /sec	m ³ /sec	ft ³ /sec
July 26-28 August 8-10 August 15-17 September 6-8 September 12-14 October 14-16 November 16-18	1.49 3.18	82.4 79.7 62.1 62.1 52.6 112.3	0.32 0.18 0.18 0.21 0.30 2.31	11.3 6.3 6.3 7.6 10.5 81.6	0.68 0.60 0.60 0.57 0.57 0.88	23.9 21.1 21.1 19.9 19.9 31.2	0.04 0.07 0.07 0.04 0.04 0.05 0.59	1.5 2.4 2.4 1.5 1.8 20.8 14.7	4.6 4.1 3.8 3.9 3.9 3.5 9.3	16.1 14.4 13.4 13.9 13.9 12.2 32.8 30.8
November 29- December 1 December 7-9 December 16-18 December 20-22	3.37	119.2	1.53 1.35 3.97 2.31	54.1 47.5 140.3 81.6	0.92	32.6	0.42	14./ 	6.8 13.3 7.8	24.1 47.1 27.6

peaked in the second week of January and reached low flow in the third week of October (Fig. 22). During the last 14 years 79% of the peak flows occurred in January or February and 72% of the low flows occurred in September or October (Table 17).

Table I?. Flows in White River at the U.S.G.S. gauging station (km 3.2) below White River Falls, 1970-1983. $^{\alpha}$

	Maxi mu	m flow	M ni mu	Minimum flow		
Year	Date	Flow	Date	Flow	flow	
1970	Jan 23	4,250	Oct 11	94	404	
1971	Jan 18	3,000	Oct 5	103	507	
1972	Jan 21	4,810	Dec 10	129	588	
1973	Dec 21	1,930	Sep 17	83	280	
1974	Jan 16	6,460	Oct 15	121	641	
1975	Jan 25	3,420	Sep 30	111	541	
1976	Jan 8	2,560	Nov 28	109	425	
1977	Dec 13	6,400	Sep 15	69	278	
1978	Feb 9	1,220	Dec 31	95	357	
1979	Feb 7	1,340	Jan 8	66	304	
1980	Dec 26	3,800	Oct 11	95	422	
1981	Feb 19	3,150	Sep 14	90	338	
1982	Feb 21	4,160	Sep 17	116	556	
1983	Jan 7	3,730	Oct 11	117	540	

a Data from 1978-1933 is provisional and subject to corrections.

Water temperature

Maximum water temperatures during summer ranged from 28.5°C in lower Tygh Creek to 9.5°C in White River at Barlow Crossing. The highest summer temperatures in the White River system were recorded in lower Tygh Creek, with maximum temperatures frequently over 250C (Fig. 23). Although a thermograph was not in operation until August 9 (the date of the peak recorded temperature), readings form maximum/minimum thermometers indicated there was at least a three week period when temperatures reached 25°C or higher (Table 18). During this period diurnal fluctuations averaged approximately 10°C (Table 18 and Fig. 23). Summer water temperatures in Tygh Creek are influenced by high air temperatures, poor streamside shading, low flow, and

Fig. 22. Mean discharge (5-day periods) in White River at U.S.G.S. gauging station (km 3.2), 1983.

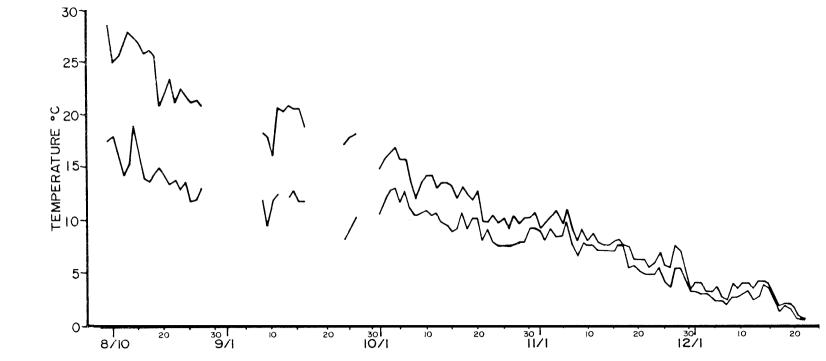


Fig. 23. Maximum and minimum daily water temperatures recorded by the Tygh Creek thermograph (km 1.3), August 9-Decmber 31, 1983.

pools behind diversion dams. The effect of these pools, which have low velocity and poor shading, is indicated by comparing maximum temperatures at km 1.3 with those at km 9.3 on Tygh Creek (Table 18). Physical characteristics (flow, air temperature, streamside shading) between the two sites are comparable, however, the upper site is above three large diversion pools which likely accounts for the 3° to 6°C increase in temperature at the lower site.

Other streams with high summer temperatures are Badger, Jordan, Rock, and fate creeks. Several pools in Rock and Gate creeks were isolated because of intermittent flow but streamside shading prevented temperatures from reaching high levels and contributed to large diurnal fluctuations.

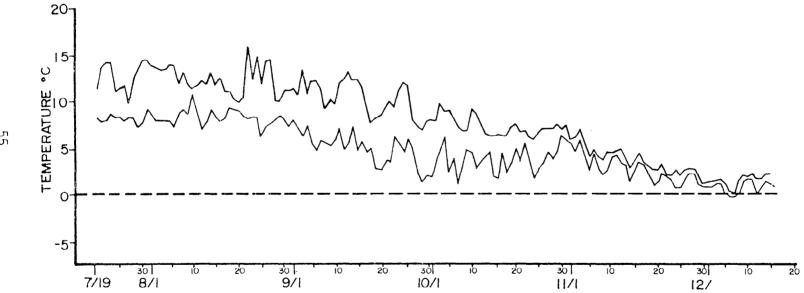
Maximum temperatures were relatively low and diurnal fluctuations were small in upper areas of the White River system (Table 18). Tributaries above km 45 on White River remained very cool with August maximums of approximately 14°C in Boulder and Barlow creeks, and approximately 13°C in Clear and Bonney creeks. Diurnal fluctuations were about 5.5°C which is almost one-ha!f the amount of fluctuation observed in the lower end of the watershed. Upper reaches of the watershed are characterized by low air temperatures, good streamside shading, and more constant flows than in lower reaches.

A wide range of maximum temperatures and diurnal fluctuations was recorded during the summer in White River at Barlow Crossing (Fig. 24). The maximum temperature was 16° C on August 22 and several daily maximums dipped to the 10° C in July and August. Diurnal fluctuations in the summer ranged from 1° to 7.5° C. The water temperatures in White River during summer are affected by giacia? melt which depresses temperature.

54

Table 18. Maximum/minimum water temperatures(°C) recorded by max/min thermometers in White River basin, 1983.

Stream, Location (km)	July 20-26	July 27- Aug 1	Aug 2- Aug 8	Aug 9- 15	Aug 16- 22	Aug 23- 30	Aug 31- Sept 6	Sept 7- 13
T 1 0 1								
Tygh Creek	06 7/15 0	06 7/15 0	,	00 7/14 4	00 1/10 1	22 0/12 0		\01 7/10 0
1.3	26.7/15.0					23.9/13.9		
9.3		23.0/16.0	22.0/15.0	20.0/14.5				->18.U/13.U
25.9		14.0/12.0	15.0/11.0	21.0/8.5				->12.0/9.0
Jordan Creek								10 4/11 1
0.2		25.0/16.0						19.4/11.1
Badger Creek								17.0/0.0
2.1	22.8/12.2	23.3/12.8	22.0/13.9	22.2/12.8	21.//11.1			->1/.8/8.9
21.6		16.3/8.3	22.2/12.8-		->13.9/7.7			->10.0/7./
Threemile Creek								
9.8		18.3/7.8	18.9/7.8		->19.4/6.1	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~		->11.1/8.9
20.0		20.0/10.0	18.9/8.9		->17.2/8.9			->15.6/5.6
Rock Creek								
17.7		26.0/10.0	22.0/11.0-		->21.0/9.0			->16.5/8.0
Gate Creek								
8.7		25.0/14.0	26.0/11.0-		->22.0/11.0			->18.0/9.0
10.3		20.0/15.0	21.5/12.0-		->20.0/10.5			->15.5/9.5
Clear Creek								
5.5	12.2/6.7	12.2/6.7	12.8/7.8	12.2/7.7	12.2/7.8			->10.6/7.8
Boulder Creek			22,07,7,10		,			
3.5	12.2/6.7	12.8/6.7			13.9/7.8			->11.7/7.7
Barlow Creek	22,02,00,							
0.2	12.8/5.6	13.3/6.7	13.3/8.9	13.9/7.7	12.2/6.7	9.4/5.0		->
Bonney Creek	12.0,0.0							
2.4		13.0/7.5			->12.0/8.0			->10.0/7.5
White River					·			
27 .4				17.2/10.0	15.6/10.0			>
6. / u T				27.27.20.0	20,0, 20,0			



Maximum and minimum daily water temperatures recorded by the upper White River thermograph at Barlow Crossing (km 59), July 20-December 16, 1983.

Moderate temperatures were recorded in lower White River (km 3. 2) during the summer with a peak temperature of 19.5°C on July 23 (Fig. 25). Several maximum temperatures were below 150C in August and diurnal fluctuation during this period was around 4oC. Temperatures in lower White River are influenced by cool upriver flows from the mainstem and upper tributaries since these flows account for most of the flow in the lower river during the summer and fall,

Estimates Of Potential

Several methods to estimate anadromous fish potential in White River have been tentatively selected through literature review and consultations with biologists. These include: (1) biomass estimates of resident fish to estimate carrying capacities, (2) a habitat quality index, (3) an index of productivity based on flow, (4) a direct relationship to production in the adjacent watershed of Warm Springs River, and (5) an expansion of rearing area by a fish per unit area multiplier. Investigation of other methods will continue in 1984.

Stream reaches within White River drainage will be selected utilizing 1983 data from ODFW and USFS stream surveys. Sampling sites within each reach will typify the habitat of that reach. Habitat parameters and biomass estimates will be measured at these sites.

The biomss of juvenile rainbow trout can be used as a measure of potential steelhead production in the system Site-specific estimates will be averaged for a stream reach, then expanded for the White River system. The potential will be adjusted for the presence of resident species and the presence of juvenile chinook utilizing data from biologists and from the literature.

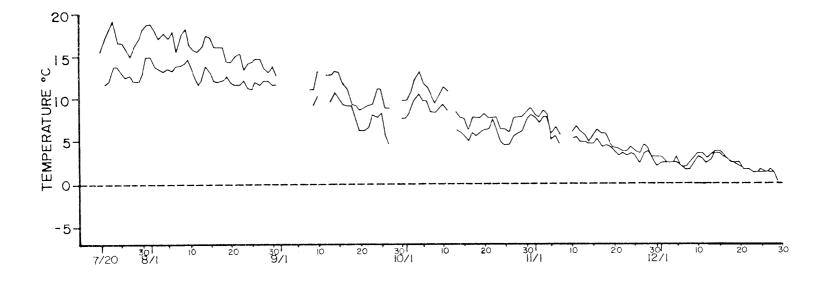


Fig. 25. Maximum and minimum daily water temperatures recorded by the lower White River thermograp (km 3.2), July 20-December 29, 1983.

A Habitat Quality Index (HQI) is being developed by USFWS personnel in Idaho. The index is based on a rainbow trout model (Binns and Eiserman, 1979) from Wyoming with modification for use on anadromous fish streams. The model relates measured habitat parameters (independent variables) to measured standing crop (dependent variable), Selected habitat parameters are entered into a multivariate model. The output of the model is lbs/acre which can be converted to fish/unit area. The development of the model for anadromous fish was not completed in 1983. Before field work begins in 1984, we will decide whether a working model will be sufficiently developed by September 1984 for use in predicting anadromous fish potential.

J.D. McIntyre (1983) developed a relationship between mean daily discharge (flow) in September and maximum yield of spring chinook smolts.

Data for the relationship came from the Warm Springs, John Day, Yakima, Lemhi rivers, and from Lookingglass Creek. Because some elements of life history and flow (irrigation diversions) were not taken into account in some of these streams, some modifications of McIntyre's relationship will be made.

Another approach to predicting potential anadromous production in White River is a direct relationship to production observed in the Warm Springs River. Potentials can be estimated by prorating mean sizes of anadromous fish in the Warm Springs by drainage area, mean annual flow, or mean flow for some critical time periods.

A measure of rearing area can also be multiplied by values of fish per unit area to estimate juvenile-smoit production in White River. The values of this multiplier will be derived from data in literature and from biologists.

Task 2.3

We exposed '20 resident fish to glacial silt in White River at Barlow Crossing from September 7 through 12. The 21 control fish were held in Barlow Creek during the same period. There was a 35% and 5% mortality in test and control groups, respectively. Gill arches of test fish were examined under magnification but exhibited no apparent damage to the lamellae. Rocks placed in the test live box were rapidly buried because of the heavy silt load and mortality in the test group was likely due to inadequate cover to escape the current.

We sampled 'lower White River (km 5.5-9.0) with electrofishing gear mounted in a driftboat on September 23 following a two-week period of heavy silt loads. We captured 227 wild rainbow trout which ranged in size from 8.4 to 37.0 cm. The overall condition of the fish was excellent in all size groups. The appearance of the fish suggested they had been feeding well despite the silt load (Fig. 26).

Spawning of adult salmon in glacial waters has been documented in Alaska (Kissner, 1582). Kissner also found that growth of young-of-the-year chinook salmon was greater in clear-water rivers than in glacial rivers, but that glacial water (mainstems) supported greater densities of rearing juveniles. We plan to further assess the behavior and condition of resident rainbow during periods of high silt loads in 1984.

Task 2.4

Habitat improvements that increase summer flow would greatly benefit fish production in White River drainage below the national forest boundary. This single measure would increase the amount of usable spawning gravel and rearing area, would improve passage at migration harriers, and would reduce water

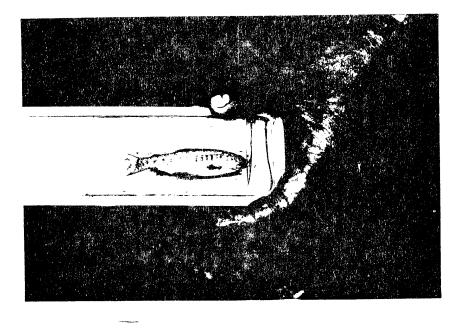


Fig. 26. Juvenile rainbow trout sampled in lower White River following a period of heavy silt load from glacial melt.

temperatures. Even with low flows, however, there is considerable habitat improvement work that could increase stream potential either by enhancing present habitat or by providing new habitat.

Habitat improvement of migration barriers was discussed in Task 1.3 for juvenile passage and Task 2.1 for adult passage.

Several areas lacked adequate pool; riffle ratios due to high gradient, boulder and bedrock substrate, or stream classification. Measures to increase pool area might include gabions, boulders, or log weirs. Tygh Creek is channelized in a 5 km section (km 11-16) and is characterized by a flashy flow regime (>2:1, high flow: low flow), low pool:riffle ratios, and an unstable substrate. The low pool:riffle ratio extends to Km 20.0 but large-scale enhancement above km 16 would be limited because of poor access. gravels were lacking on Jordan Creek above Km 5; however, improvements in this area would be contingent upon passage at Jordan Creek Falls. Enhancement on Badger Creek from km 4.0 to km 10.0 would include improvement in the pool:riffle ratio which presently ranges from 10:90 to 30:70. Pool:riffle ratios on Threemile, Gate, and Rock creeks (57:43) indicate good pool development with perrenial flows; however, these creeks are characterized by very low to intermittent summer flows.

Eroded streambanks and denuded streamside vegetation were identified to varying degrees on all the streams below the forest boundary. Rip-rap and rock deflectors could be used to stabilize streambanks, buffer strips left during logging, and streamside fencing to protect riparian vegetation from grazing would also improve these conditions. Major bank erosion on Tygh Creek was limited to areas in the Km 20-24 section due to past logging practices. Unfortunately, remedial measures in this section would be

restricted because of poor access. A small section of Jordan Creek (km 5.0-6.5) was subject to active erosion and needs rip-rap or rock deflectors. Livestock overgrazing of the riparian zone was observed on Badger Creek from Km 5.0 to 6.5 in the White River Wildlife Management Area (WRVMA), managed by **ODFW** Some bank erosion was also evident. Extensive overgrazing and severe bank erosion was observed on Threemile and Rock creeks within the management On Threemile Creek bank erosion was noted on 40-60% of the stream from Km 16.0 to Km 20.5 and was accompanied by poor development of the riparian Heavy grazing on Rock Creek from Km 8.0 to Km 10.5 resulted in bank erosion of up to 70% in one 0.8 km section. More severe erosion on Rock Creek was prevented by beaver dams which raised the water level in some areas and allowed lush growth of stream side grasses. Riparian zones on Gate Creek were also poorly developed and were heavily used. Sections of private land heavily grazed were located on Threemile (km 2.5-4.0, km 9.0-10.0), and in small areas of Rock and Gate creeks.

Effects of severe bank erosion is evident in the composition of riffle substrates in Threemile and Rock creeks, The average percentage of fine gravel and silt in these two creeks (26%) is over five times that observed in the Tygh-Badger system (5%) (Table 13).

Several reaches of streams within the survey area had low amounts of cover in pools which may limit the area suitable for rearing. In-stream structures such as boulders and large woody debris would increase the potential of these pools. Areas with little cover in pools were identified in Tygh Creek below the confluence with Jordan Creek (km 0.0-15.0), Badger Creek (km 7.2-9.7), and much of Threemile, Rock, and Gate creeks.

A potential pollution source was identified near the Mountain Fir Lumber Company in Tygh Valley, A lagoon, with an unknown waste, overflows into an old channel of Tygh Creek which has an outlet into the creek. The nature of the effluent will be determined to assess potential impacts on the water quality in Tygh Creek.

Task 3.1

We sampled 168 sites to identify fish species in White River drainage from July 14 to October 20. Tributaries were sampled intensively from July 14 to September 8. A 3.5 km section of mainstem White River was sampled above and below the confluence of Tygh Creek where access allowed use of boat electrofishing gear. The mainstem is difficult to sample for fish because of its large size, inaccessibility, and turbidity in summer and early fall.

Salmonids present in White River basin are rainbow trout (Salmo gairdneri), Eastern brook trout (Salvelinus fontinalis), and mountain whitefish (Prosopium williamsoni). Non-salmonids are sculpins (Cottus beldingi and C. confusus were identified; C. rhotheus and C. bairdi may also be present), longnose dace (Rhinicthys cataractae), and largemouth bass (Micropterus salmoids).

Rainbow trout were widely distributed throughout the system (Fig. 27). Their range extended to the upper reaches of most tributaries where stream flows and gradients became limited or migration barriers were encountered. The major except i on to this was in the Clear Creek system where the rainbow trout arc: displaced by brook trout above km 8.0 and km 0.6 in Clear and Frog creeks, respectively.

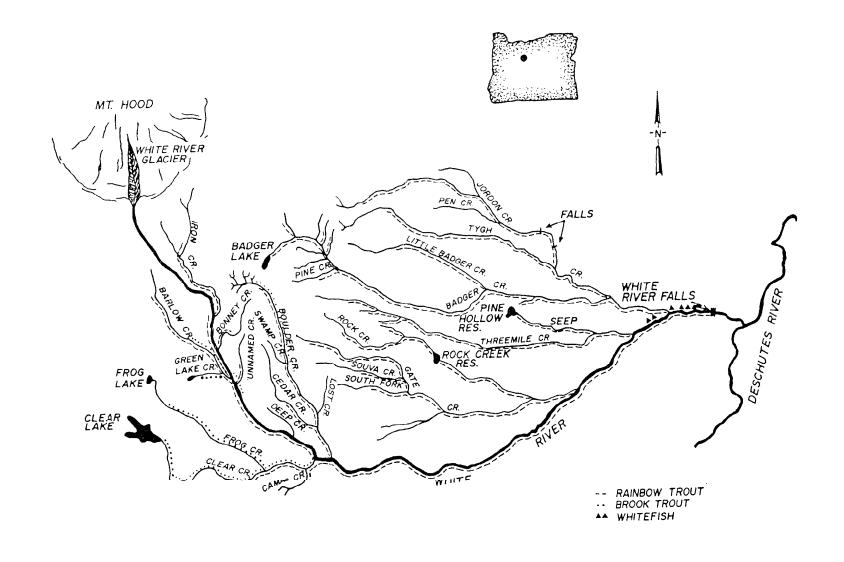


Fig. 27. Distribution of salmonids in the White River system (above the falls).

Brook trout were found only in the uppermost areas of the watershed, above Km 45.0 on White River (Fig. 27). Although we did not find brook trout in Badger Creek, they are probably present because they are in Badger Lake.

The __extensive distribution of brook trout was in Clear Creek system above km 5.0.

Whitefish were found only in the lower mainstem (km 5.5-9.0), although their upstream distribution is not certain because of poor access above this point (Fig. 27). Whitefish were not found in any tributaries.

Sculpins were distributed widely throughout much of the drainage (Fig. 28). Sculpins were distributed below the 670 m elevation contour in the Tygh-Badger system with the exception of Jordan Creek where they were not found above the second falls. Distribution of sculpins was very limited in Rock and Gate creeks and none were found in Threemile and Boulder creeks.

Longnose dace were limited to the mouth of Threemile Creek and to a small seep below Fine Hollow Reservoir. The distribution of largemouth bass was confined to a small section below Rock Creek Reservoir.

The relative abundance of rainbow trout in White River generally decreased from lower to upper reaches of the system (Fig. 29). The notable exception to this tendency was an increase in abundance of the 5-10 cm group at 500-699 m elevation because of increases in abundance of rainbow in Threemile and Gate creeks. The general decrease of abundance in the upper reaches is probably due to reduced rearing habitat in the smaller streams. Logically, the smallest size group (fry) should have composed the greatest percentage of trout in the sample, however, electrofishing gear is not efficient in capturing small fish,The most abundant size groups in our samples were 5-10 and 10-15 cm. Rainbow greater than 15 cm comprised 13% of the sample.

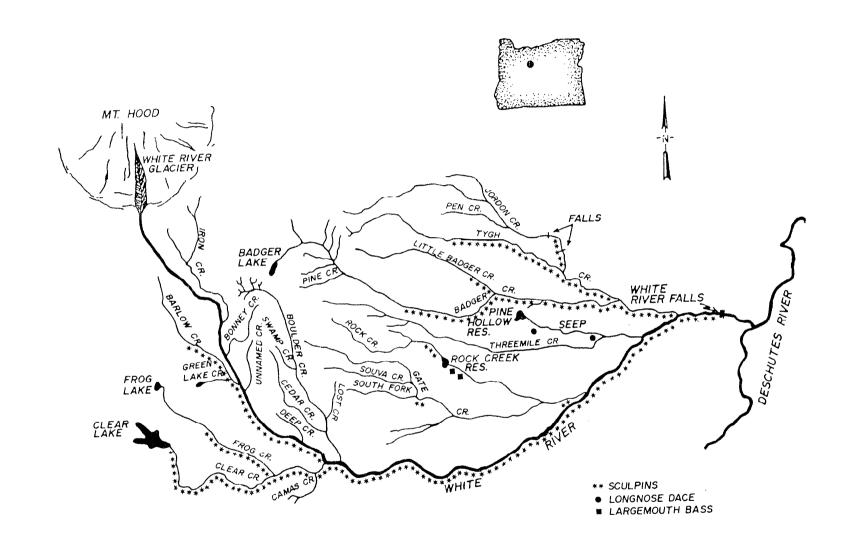


Fig. 28. Distribution of sculpins, dace, and bass in the White River system (above the falls).

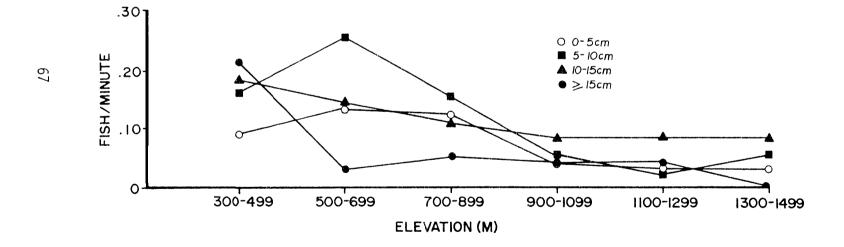


Fig 29 Mean catch per minute (electrofishing) of rainbow trout in the White River system, 1983

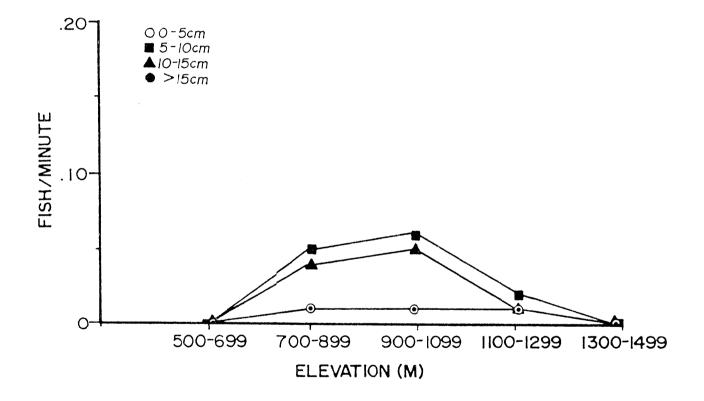
Brook trout were not found below the 700 m elevation contour (Fig. 30). Relative abundance was generally stable from 700 to 1,100 m before declining at higher elevations where the streams are small and offer limited rearing habitat. Of the brook trout sampled, 90% were in Clear and Frog creeks. The catch of sculpins were not found above 1,100 m (Fig. 31).

Rainbow trout in tributaries of White River are small (Fig. 32). Of the rainbow sampled, 90% were \leq 150 mm, Larger rainbow trout were captured with boat electrofishing gear in the mainstem of lower White River (Fig. 33). The mean length of these fish was twice that in the tributaries. These data indicate better growth or a migration of larger trout to White River and lower reaches of the tributaries.

Brook trout in tributaries of White River are also small (Fig. 34). Almost 95% of the fish sampled were \leq 150 mm, with only one greater than 200 mm

Task 3.2

Virus checks were run on 269 rainbow trout and 200 brook trout from six sites in the White River system (Table 19). Parasitogical and bacteriological examinations were performed on 85 rainbow trout, 45 brook trout, and 2 whitefish from 11 sites (Table 20).



ig 30 Mean catch per minute (electrofishing) of brook trout in the White River system, 1983

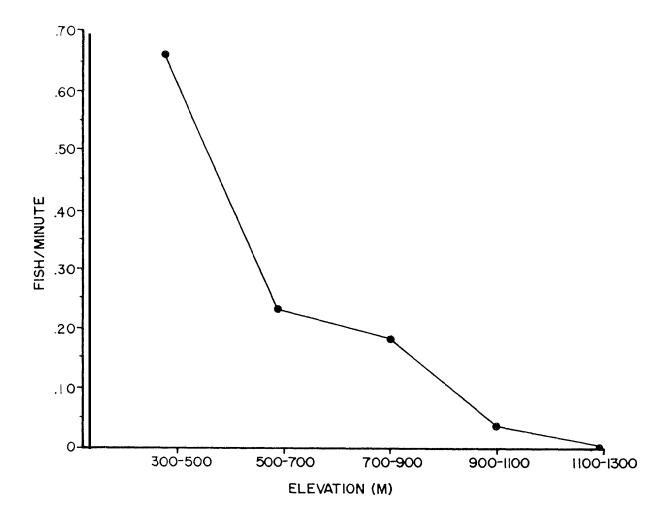


Fig. 31 Mean catch per minute (electrofishing) of sculpins in the White River system, 1983.

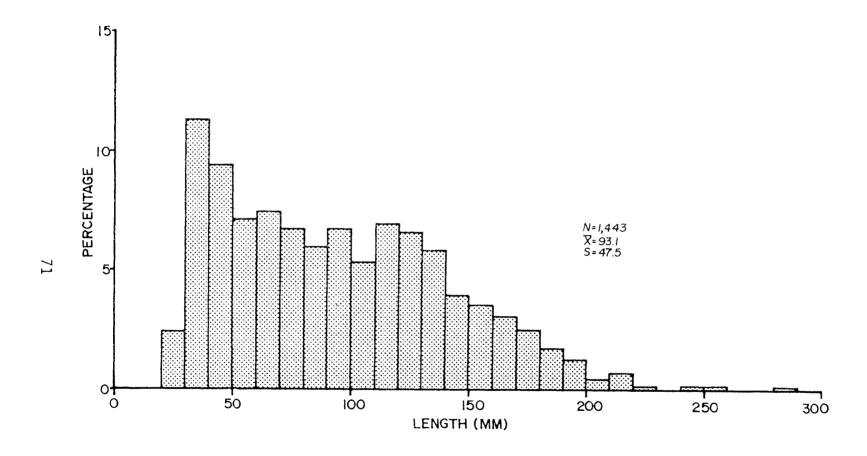


Fig. 32 Length frequency distribution of rainbow trout in tributaries of White River, 1983.

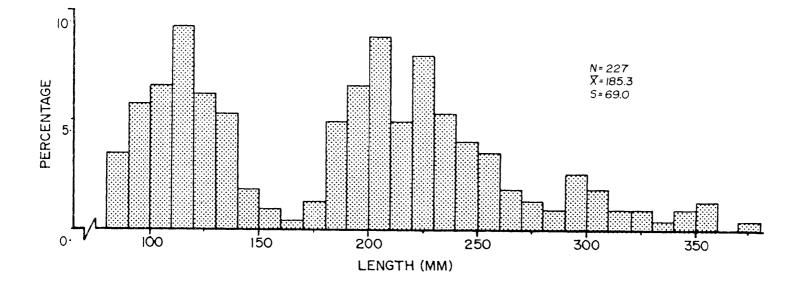
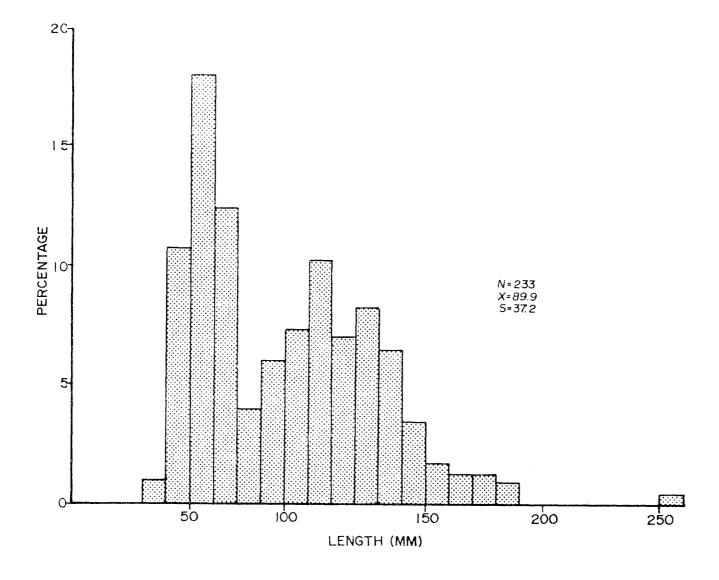


Fig. 33. Length frequ distribution of rainbow trout in lower White River (boat electrofishing), 1983



ig 34 Length requency distribution of brook trout in tributaries of White River, 1983

Table 19. Numbers of rainbow and brook trout collected at six locations in the White River basin and found negative for IHN and IPN viruses.

Location	Rai nbow	Brook Trout
Badger Lake	0	67
Boulder Creek	53	18
White River and Tributaries	142	0
below km 30		
Barlow Creek	60	11
Clear Creek	2	34
Clear Lake	12	70

Table 20. Parasites and bacterial pathogens found in rainbow and brook trout in White River, 1983.

Location	Pathogens
Badger Lake	Gyrodactylus, Copepods, Strigeids
Jordan Creek	Mi crospori dans
Tygh Creek	Crepidostomm Strigeids
White River	Hexamita, Microsporidans, Myxosoma squamalis, Nanophyetussalmincola
Threemile Creek	Gryodactylus, Nanophyetus salmincola, Crepidostomum
Gate Creek	Gyrodactylus, Crepidostomum, Lactobacillus, motile areomonad
Rock Creek	Crepi dostomum
Boulder Creek	Bacterial kidney disease, Gyrodactylus, Trycophrya, Crepidostomum, Nematodes, Lactobacillus
Clear Creek	Bacterial kidney disease, Hexamita, Chloromyxum, Crepidostomum, Nematodes
Clear Lake	Bacterial kidney disease, Cytophaga psychrophila (cold water disease), Chloromyxum, Crepidostomum
Barlow Creek	Bacterial kidney disease, Chloronyxum, Myxosoma squamalis, Gyrodactylus, Crepidostomum, Nemtodes

There were no viruses detected in any of the fish sampled and few parasites were found. Most of the parasites were protozoans and trematodes and are ubiquitous for salmonids. Bacterial kidney disease (BKD) was found in fish from Boulder, Barlow, and Clear creeks, and from Clear Lake, These areas are above km 45 in the White River drainage.

SUMMARY

Task 1.2

- A. Recapture rates of juvenile chinook released above (test) and below (control) White River Falls did not differ significantly during high flows (300-500 cfs).
- B. Recapture rates of test and control releases of juvenile steelhead did not differ significantly, but with low recapture samples (n = 2-33) interpretation of the data is tenuous. It appears the steelhead released into White River did not actively migrate.
- c. Recapture rates of test chinook were significantly lower than for control releases of low flows (115-150 cfs). Releases in the south channel were recaptured at a 27% lower rate than were the two north channel releases. Recaptures of releases in the south main channel were 54% lower than from release below the falls. The differences between test and control recapture rates may be due to mortality in the 43 m free fall or may be due to a lack of migration by the smaller fish.
- The mean length of test fish was significantly larger at recapture than at release during the low flow period. There was no difference between the mean length of control releases and the length of control recaptures. This difference may be due to mortality of smaller fish in the free fall or it may be due to a lack of migration by smaller fish.
- Injuries observed during low flow were 3.5% of the recaptures.

 There was no apparent delayed nortality in the test fish. There were no dead fish observed along the shore below the falls.

Task 1.3

A. Twenty water diversions for irrigation were identified. These included 10 diversion ditches and 10 pumps. Estimated withdrawal on Tygh Creek was 16-18 cfs, which left 7 cfs at the mouth.

Withdrawals on Badger Creek removed 13 cfs with less than 2 cfs remaining at its mouth. The entire flow of Threemile Creek was diverted at km 19.2, which left a dry channel for 5 km downstream All diversion ditches would require screening to protect downstream migrants.

Task 2.1

- A. Several methods to estimate the anadromous fish potential of the White River system have been tentatively selected through literature review and consultations with biologists. These include, but are not limited to, biomass estimates of resident fish to estimate carrying capacities, a habitat quality index, an index of productivity based on flow, a direct relationship to production in neighboring Warm Springs River, and an expansion of rearing area by a fish per unit area multiplier. Investigation into additional methods will continue in 1984.
- B. There is 4,306 n2 of good spawning gravel and 4,019 n2 of good marginal spawning gravel in 94 km of seven tributary streams. An additional 1,500 n2 of spawning gravel was exposed during low "low. Gravel in the seven streams will be assessed during higher flows.

- C. We identified 138 major pools in seven tributaries. Lower Tygh and Badger creeks contained 29% of the pools and 20% were in Threemile Creek.
- 0. Of the 13 migration barriers identified, 10 were irrigation diversion dams. There was a 3.1 m waterfall on Tygh Creek and 2 waterfalls on Jordan Creek that were 5.2 and 7.6 m high.
- E. Mean daily flow in White River measured by U.S. Geological Survey near the mouth since 1970 averaged 442 cfs and ranged from 278 to 641 cfs. Mean maximum and minimum flows were 3,588 and 100 cfs, respectively. Seventy-two percent of the mainstem flow from July through November was accounted for by flows in White River at Barlow Crossing in Tygh Creek, in Clear Creek, and in Boulder Creek in 1983.
- F. Maximum water temperatures ranged from 25°C to 28.5°C in Tygh,

 Jordan, Rock, and Gate creeks. The minimums on these four creeks

 ranged from 10°-19°. High water temperatures in lower Tygh Creek

 'were influenced by warming of large pools behind diversion dams.

 Cooler water temperatures were recorded in stream reaches at higher

 elevations with maximum of 13-14°C and minimums of about 8°C.

 Moderate water temperatures were recorded in White River near the

 mouth with a peak of 19.5°C. Temperatures in the mainstem are

 influenced by White River Glacier with maximum temperatures as low

 as 10°C in July and August in the upper mainstem

Task 2.3

A. Results of testing the effects of glacial silt on juvenile salmonids were inconclusive. Silt in the river filled in the test live box and lack of cover may have caused mortality in the test group.

Observations of 227 rainbow trout captured in the lower mainstem immediately following a period of siltation indicated the fish were in good condition despite the silt load.

Task 2.4

A. Habitat improvement opportunities on the seven survey streams included improved upstream passage, in-stream structures to develop pools and to retain gravels, structures for decreasing bank erosion, and streamside fencing to protect the riparian zone. Passage problems were identified at diversion dams, waterfalls, and woody debris dams. Possibilities for improved pool:riffle ratios were identified in sections of Tygh and Badger creeks. Need for streamside fencing and bank stabilization was identified on most stream sections within the White River Wildlife Management Area.

Task 3.1

A. We sampled fish at 168 sites in White River and tributaries.

Intensive sampling in the mainstem was limited to the lower river with boat electrofishing gear. The remainder of the mainstem was not sampled very intensively because of inaccessibility and the large size of the river.

- B. Resident salmonids sampled in the White River system were rainbow trout, brook trout, and whitefish. Other species sampled were cottids, dace, and largementh bass.
- C. Rainbow trout were the most widely distributed fish in the watershed. Brook trout were limited to the upper reaches of the system and whitefish were located only in the lower mainstem
- D. Sculpins were well distributed in the system with the exception of Jordan Creek above the second falls, and Boulder and Threemile creeks. Abundance was very limited in Rock and Gate creeks. Dace and bass were limited to only a few small areas.
- E. The relative abundance of rainbow trout generally decreased from lower to higher elevations. The most abundant size groups were 5-10 cm (31%) and 10-15 cm (28%).
- F. Brook trout were found in streams at elevations of 700 to 1,100 m but decreased rapidly above 1,100 m. Ninety percent of the brood trout sampled were in Clear and Frog creeks. The most abundant size groups for brook trout were 5-E cm (41%) and 10-15 cm (40%).
- G. Cottids were most abundant in the lower reaches of the White River system There were no cottids located above the 1,100 m elevation contour.
- H. The length composition of rainbow trout and brook trout in the tributaries was dominated by small fish with 90% and 95% < 150 mm respectively. In the lower section of White River 62% of the rainbow trout were > 150 mm

Task 3.2

A. There were no viruses detected in samples of 269 rainbow trout and 200 brook trout. The samples were collected in streams throughout the system as well as Clear and Badger lakes. Bacterial kidney disease was detected in both rainbow and brook trout from Boulder, Barlow, and Clear creeks and in Clear Lake.

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